

## **CLAIMS**

I/We Claim:

1. A cooling system for use in a direct chilled casting mold system with a mold cavity, the mold system being configured for molding a metal castpart, the cooling system comprising:

a cooling framework configured for location around a perimeter of a mold cavity, the cooling framework comprising:

a first plurality of coolant discharge apertures

configured at a first end to receive coolant at a first coolant flow rate, and  
configured at a second end to discharge a first discharge coolant flow at a  
first coolant discharge velocity toward a first fractional surface portion of a  
castpart being molded;

a second plurality of coolant discharge apertures

configured at a first end to receive coolant at a second coolant flow rate,  
and

configured at a second end to discharge a second discharge coolant flow  
at a second coolant discharge velocity toward a second fractional surface  
portion of the castpart;

wherein the first coolant flow rate is approximately equal to the second coolant flow rate;  
and further wherein the first coolant discharge velocity is less than the second coolant  
discharge velocity.

2. A cooling system as recited in claim 1, and further wherein the coolant is water.
3. A cooling system as recited in claim 1, and further wherein the coolant comprises water.
4. A cooling system as recited in claim 1, and further wherein the coolant is a mixture of water and carbon dioxide.
5. A cooling system as recited in claim 1, and further wherein the first fractional surface portion is a center portion and the second fractional surface portion is a quarter portion.
6. A cooling system as recited in claim 1, and further wherein the first fractional surface portion is a center portion and the second fractional surface portion is a one-third portion.
7. A cooling system as recited in claim 1, and further wherein the first fractional surface portion and the second fractional surface portion are adjacent one another around the perimeter of a mold cavity.
8. A cooling system as recited in claim 1, and further wherein the first fractional surface portion and the second fractional surface portion are spaced apart from one another around the perimeter of a mold cavity.

9. A cooling system as recited in claim 1, and further wherein the casting mold system is configured to cast an ingot shaped castpart.
10. A cooling system as recited in claim 1, and further wherein the first coolant flow rate is within four percent of the second coolant flow rate.
11. A cooling system as recited in claim 1, and further wherein the first coolant flow rate is within eight percent of the second coolant flow rate.
12. A cooling system as recited in claim 1, and further wherein the first coolant flow rate is within twelve percent of the second coolant flow rate.
13. A cooling system as recited in claim 1, and further wherein heat transfer from the castpart to the first discharge coolant flow is less than heat transfer to the second discharge coolant flow due.
14. A cooling system as recited in claim 1, and further wherein the first discharge coolant flow is less than the second discharge coolant flow.

15. A cooling system for use in a direct chilled casting mold system with a mold cavity, the mold system being configured for molding a metal castpart, the cooling system comprising:

a cooling framework configured for location around a perimeter of a mold cavity, the cooling framework comprising:

a first plurality of coolant discharge apertures

configured at a first end to receive coolant at a first coolant flow rate, and  
configured at a second end to discharge a first discharge coolant flow at a  
first coolant discharge velocity toward a first fractional surface portion of a  
castpart being molded;

a second plurality of coolant discharge apertures

configured at a first end to receive coolant at a second coolant flow rate,  
and

configured at a second end to discharge a second discharge coolant flow  
at a second coolant discharge velocity toward a second fractional surface  
portion of the castpart;

wherein the first coolant flow rate is approximately equal to the second coolant flow rate;  
and wherein the first discharge flow rate is lower than the second discharge flow rate.

16. A cooling system as recited in claim 15, and further wherein the first coolant  
discharge velocity is less than the second coolant discharge velocity.

17. A cooling system as recited in claim 15, and further wherein the coolant comprises water.
18. A cooling system as recited in claim 15, and further wherein the coolant is a mixture of water and a gas.
19. A cooling system as recited in claim 15, and further wherein the first fractional surface portion is a center portion and the second fractional surface portion is a quarter portion.
20. A cooling system as recited in claim 15, and further wherein the first fractional surface portion is a center portion and the second fractional surface portion is a one-third portion.
21. A cooling system as recited in claim 15, and further wherein the first fractional surface portion and the second fractional surface portion are adjacent one another around the perimeter of a mold cavity.
22. A cooling system as recited in claim 15, and further wherein the first fractional surface portion and the second fractional surface portion are spaced apart from one another around the perimeter of a mold cavity.

23. A cooling system as recited in claim 15, and further wherein the casting mold system is configured to cast an ingot shaped castpart.
24. A cooling system as recited in claim 15, and further wherein the first coolant flow rate is within four percent of the second coolant flow rate.
25. A cooling system as recited in claim 15, and further wherein the first coolant flow rate is within eight percent of the second coolant flow rate.
26. A cooling system as recited in claim 15, and further wherein the first coolant flow rate is within twelve percent of the second coolant flow rate.
27. A cooling system as recited in claim 15, and further wherein heat transfer from the castpart to the first discharge coolant flow is less than heat transfer to the second discharge coolant flow due.
28. A cooling system for use in a direct chilled casting mold system with a mold cavity, the mold system being configured for molding a metal castpart, the cooling system comprising:  
a cooling framework configured for location around a perimeter of a mold cavity, the cooling framework comprising:  
a first plurality of coolant discharge apertures  
configured at a first end to receive coolant at a first coolant flow rate, and

configured at a second end to discharge a first discharge coolant flow at a first coolant discharge velocity toward a first fractional surface portion of a castpart being molded;

a second plurality of coolant discharge apertures configured at a first end to receive coolant at a second coolant flow rate, and

configured at a second end to discharge a second discharge coolant flow at a second coolant discharge velocity toward a second fractional surface portion of the castpart;

wherein the first coolant flow rate is approximately equal to the second coolant flow rate; wherein the first discharge coolant flow creates a higher average steam stain on the first fractional surface portion than the second discharge coolant flow creates on the second fractional surface portion of the castpart.

29. A cooling system as recited in claim 28, and further wherein the first fractional surface portion is a center portion and the second fractional surface portion is a quarter portion.

30. A cooling system as recited in claim 28, and further wherein the first fractional surface portion is a center portion and the second fractional surface portion is a one-third portion.

31. A cooling system as recited in claim 28, and further wherein the first fractional surface portion and the second fractional surface portion are adjacent one another around the perimeter of a mold cavity.

32. A cooling system as recited in claim 28, and further wherein the first fractional surface portion and the second fractional surface portion are spaced apart from one another around the perimeter of a mold cavity.

33. A cooling system as recited in claim 28, and further wherein the coolant comprises water.

34. A cooling system for use in a direct chilled casting mold system with a mold cavity, the mold system being configured for molding a metal castpart, the cooling system comprising:

a cooling framework configured for location around a perimeter of a mold cavity, the cooling framework comprising:

a first plurality of coolant discharge apertures

configured at a first end to receive coolant at a first coolant flow rate, and  
configured at a second end to discharge a first discharge coolant flow at a  
first coolant discharge velocity toward a first fractional surface portion of a  
castpart being molded;

a second plurality of coolant discharge apertures

configured at a first end to receive coolant at a second coolant flow rate,

and

configured at a second end to discharge a second discharge coolant flow at a second coolant discharge velocity toward a second fractional surface portion of the castpart;

wherein the first coolant flow rate is approximately equal to the second coolant flow rate; further wherein the first plurality of coolant discharge apertures discharge the first discharge coolant and the second plurality of coolant discharge apertures discharge the second discharge coolant; and still further wherein heat transfer to the first discharge coolant flow is less than heat transfer to the second discharge coolant flow.

35. A direct chilled casting mold with a mold cavity configured for casting a metal castpart, and a cooling system, the cooling system comprising:  
a cooling framework configured for location around a perimeter of the mold cavity, the cooling framework comprising:

a first plurality of coolant discharge apertures

configured at a first end to receive coolant at a first coolant flow rate, and configured at a second end to discharge a first discharge coolant flow toward a center surface portion of a castpart being molded;

a second plurality of coolant discharge apertures

configured at a first end to receive coolant at a second coolant flow rate, and

configured at a second end to discharge a second discharge coolant flow toward a fractional surface portion of the castpart;

wherein the first coolant flow rate is approximately equal to the second coolant flow rate; further wherein the first plurality of coolant discharge apertures discharge the first discharge coolant and the second plurality of coolant discharge apertures discharge the second discharge coolant; and still further wherein the first discharge coolant flow is discharged relative to the second discharge coolant flow such that less heat is transferred to the first discharge coolant flow than to the second discharge coolant flow.

36. A method for changing the cooling system on an existing direct chilled molten metal mold system which includes a plurality of coolant discharge apertures around a perimeter of a mold cavity, wherein each of the plurality of coolant discharge apertures have the same approximate cross-sectional input area, comprising:  
altering an internal surface of the coolant discharge aperture at a discharge end of the coolant discharge aperture.

37. A method as recited in claim 36, and further wherein the internal surface of the coolant discharge aperture is altered by increasing its cross-sectional area at the discharge end.

38. A method as recited in claim 36, and further wherein the internal surface of the coolant discharge aperture is altered by drilling a larger diameter coolant discharge aperture at the discharge end.

39. A method as recited in claim 36, and further wherein the internal surface of the coolant discharge aperture is altered by increasing surface roughness of the internal surface at the discharge end.
40. A method as recited in claim 36, and further wherein the internal surface of the coolant discharge aperture is altered by imparting detents in the internal surface at the discharge end.
41. A method as recited in claim 36, and further wherein the internal surface of the coolant discharge aperture is altered by imparting internal threads on the internal surface.